In the Claims

Claims 1-18 are cancelled without prejudice.

New claims 40-46 are entered.

Claims 20 and 23 have been amended as shown below.

In response to the election/restriction requirement set forth in a telephone conversation with the Examiner on April 16, 2003, Applicant respectfully elects Group II, claims 19-39, drawn to a motor control circuit, for examination herein, as shown in the following version of the entire set of pending claims. Underlines indicate insertions; ~~strikeoiuts~~ indicate deletions.

1-18. (Cancelled)

19. (Original) An active vibration control system for an axially reciprocating machine, comprising:

a housing;

a linear alternator having a stator rigidly carried by the housing and a mover supported for axially reciprocating movement;

a counterbalance mass provided for axially reciprocating movement along an axis substantially coaxial with a motion axis of the mover of the linear alternator;

a linear actuator communicating with the mass, carried by the housing, and configured to move the counterbalance mass relative to the alternator at a substantially common frequency; and

analog control circuitry communicating with the linear actuator and user adjustable to adjust displacement amplitude of the linear actuator relative to the mover of the linear alternator.

20. (Currently amended) ~~The control system of claim 19 wherein the analog control circuitry comprises~~ An active vibration control system for an axially reciprocating machine, comprising:

a housing;

a linear alternator having a stator rigidly carried by the housing and a mover supported for axially reciprocating movement;

a counterbalance mass provided for axially reciprocating movement along an axis substantially coaxial with a motion axis of the mover of the linear alternator;

a linear actuator communicating with the mass, carried by the housing, and configured to move the counterbalance mass relative to the alternator at a substantially common frequency; and

analog control circuitry including voltage divider circuitry, the analog control circuitry communicating with the linear actuator and user adjustable to adjust displacement amplitude of the linear actuator relative to the mover of the linear alternator.

21. (Original) The control system of claim 20 wherein the voltage divider circuitry comprises a variable resistor and a tuning capacitor.

22. (Original) The control system of claim 20 wherein the linear alternator and the linear actuator operate at different operating voltages, and the voltage divider circuitry couples together the linear alternator and the linear actuator so as to accommodate the respective different operating voltages.

23. (Currently amended) ~~The control system of claim 19 wherein the analog control circuitry comprises~~ An active vibration control system for an axially reciprocating machine, comprising:

a housing;

a linear alternator having a stator rigidly carried by the housing and a mover supported for axially reciprocating movement;

a counterbalance mass provided for axially reciprocating movement along an axis substantially coaxial with a motion axis of the mover of the linear alternator;

a linear actuator communicating with the mass, carried by the housing, and configured to move the counterbalance mass relative to the alternator at a substantially common frequency; and

analog control circuitry including decoupling circuitry, the analog control circuitry communicating with the linear actuator and user adjustable to adjust displacement amplitude of the linear actuator relative to the mover of the linear alternator.

24. (Original) The control system of claim 23 wherein the decoupling circuitry comprises a variable transformer and a tuning capacitor, wherein the variable transformer electromagnetically couples together the linear alternator and the linear actuator.

25. (Original) The control system of claim 19 further comprising a fast Fourier transform (FFT) analyzer configured to detect vibration frequencies of the axially reciprocating machine, wherein the analog control circuitry cooperates with the FFT analyzer to adjustably control the linear actuator and reduce the detected vibration frequencies.

26. (Original) The control system of claim 19 further comprising a vibration force detector coupled with the housing and operative to generate a vibration force generated by the axially reciprocating machine.

27. (Original) A vibration control system for linear reciprocating machines, comprising:

a first axially reciprocating machine;

a second axially reciprocating machine rigidly mounted in aligned relation with the first axially reciprocating machine, electrically coupled with the first axially reciprocating machine, and operated in synchronized, opposed directions relative to the first axially reciprocating machine;

first tuning circuitry associated with the first axially reciprocating machine; and

second tuning circuitry associated with the second axially reciprocating machine;

wherein one of power to at least one of the machines and a tuning factor for at least one of the first tuning circuitry and the second tuning circuitry is adjusted to minimize vibration for the linear reciprocating machines.

28. (Original) The control system of claim 27 wherein the first tuning circuitry comprises a first tuning capacitor and the second tuning circuitry comprises a second tuning capacitor, and wherein the tuning factor comprises a capacitance value for at least one of the first tuning capacitor and the second tuning capacitor.

29. (Original) The control system of claim 28 further comprising a vibration force detector and a vibration controller, wherein the vibration controller receives a signal indicative of detected vibration forces of the system, and, in response to the signal, the controller regulates at least one of operation of at least one of the machines and a capacitance value of at least one of the tuning capacitors so as to substantially reduce the detected vibration forces.

30. (Original) The control system of claim 29 wherein the controller adjusts power generated by one of the reciprocating machines.

31. (Original) The control system of claim 29 wherein the controller adjusts capacitance value for one of the first capacitor and the second capacitor.

32. (Original) The control system of claim 29 wherein power to the reciprocating machines and capacitance values for the tuning capacitors are adjusted so as to substantially reduce detected vibration forces for a primary mode vibration frequency, and further comprising a linear alternator and a counterbalance mass, the linear alternator having a stator rigidly carried by at least one of the machines and a mover supported for axial reciprocating movement, the counterbalance mass carried by the mover for axially reciprocating movement along an axis parallel with a motion axis of the mover.

33. (Original) The control system of claim 32 wherein the counterbalance mass comprises at least one balance mass disposed such that a net effective balance mass is coaxial with an axis of reciprocation of the generator.

34. (Original) The control system of claim 32 wherein the control system controllably regulates operation of the linear alternator to move the counterbalance mass so as to reduce vibration at a secondary mode of the vibration frequency.

35. (Original) The control system of claim 28 wherein the first tuning circuitry and the second tuning circuitry comprises a digital signal processor

configured to implement power factor correction circuitry that implements digital tuning by changing current phase angle and relationship relative to voltage so as to realize a power factor of unity.

36. (Original) A method for controlling vibration from axially reciprocating machines, comprising:

providing a first axially reciprocating machine with an associated first tuning circuitry and a second axially reciprocating machine with a second tuning circuitry, wherein the first machine and the second machine are rigidly mounted together in axially aligned relation;

AC coupling the first axially reciprocating machine with the second axially reciprocating machine;

operating the first machine and the second machine in synchronized, opposed directions; and

adjusting power to at least one of the machines or adjusting a tuning value for at least one of the first tuning circuitry and the second tuning circuitry to minimize vibration for the axially reciprocating machines.

37. (Original) The method of claim 36 wherein the first tuning circuitry comprises a first tuning capacitor and the second tuning circuitry comprises a second tuning capacitor, wherein the tuning value for each of the first tuning capacitor and the second tuning capacitor each comprises a capacitance value.

38. (Original) The method of claim 37 further comprising controllably regulating a capacitance value for at least one of the tuning capacitors to decrease vibration forces.

39. (Original) The method of claim 37 further comprising controllably regulating power delivery to at least one of the machines to minimize vibration forces.

40. (New) The control system of claim 19 further comprising a Fast Fourier transform (FFT) analyzer and a vibration force detector, the FFT analyzer configured to detect vibration frequencies of the axially reciprocating machine, wherein the analog control circuitry cooperates with the FFT analyzer to adjustably control the linear actuator and reduce the detected vibration frequencies, and the vibration force detector is coupled with the housing and operative to generate a vibration force generated by the axially reciprocating machine.

41. (New) A vibration control system for linear reciprocating machines, comprising:

a first axially reciprocating machine; and

a second axially reciprocating machine affixed in substantially force-opposed relation with the first axially reciprocating machine, and configured for

operation in a synchronized, opposed direction relative to the first axially reciprocating machine;

wherein power to at least one of the machines is adjusted to minimize combined vibration for the reciprocating machines.

42. (New) The control system of claim 41 further comprising first tuning circuitry associated with the first axially reciprocating machine.

43. (New) The control system of claim 42 further comprising second tuning circuitry associated with the second axially reciprocating machine.

44. (New) The control system of claim 43 wherein the first axially reciprocating machine is electrically coupled with the second axially reciprocating machine, and wherein a tuning factor for at least one of the first tuning circuitry and the second tuning circuitry is adjusted to minimize combined vibration for the reciprocating machines.

45. (New) The control system of claim 42 wherein the first tuning circuitry comprises a first tuning capacitor, and wherein a tuning factor comprising a capacitance value for the first tuning capacitor is adjusted to minimize combined vibration for the reciprocating machines.

46. (New) The control system of claim 41 further comprising a vibration detector and a vibration controller, the vibration detector configured to generate a signal indicative of detected vibration forces of the system, and, in response to the signal, the controller is configured to regulate operation of at least one of the machines to substantially reduce the detected vibration forces of the system.